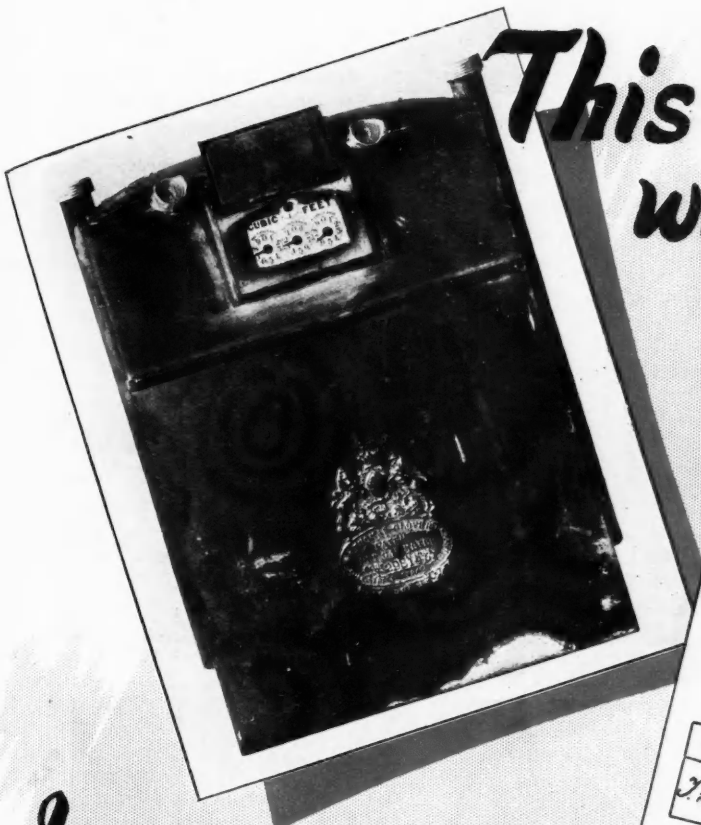
SEP 24 1941

Gas Journal

LIGHT - HEAT - POWER - BY-PRODUCTS

Vol. 235. 93rd Year. LONDON, AUGUST 20, 1941. Registered as a Newspaper No. 4083. Price 1/-



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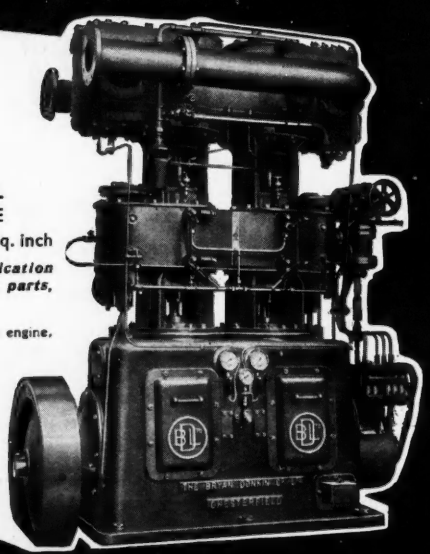

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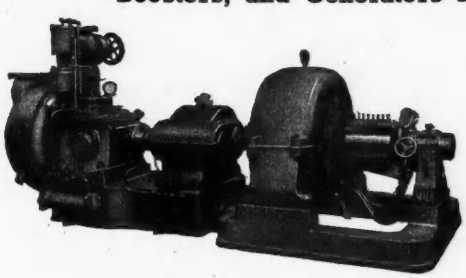

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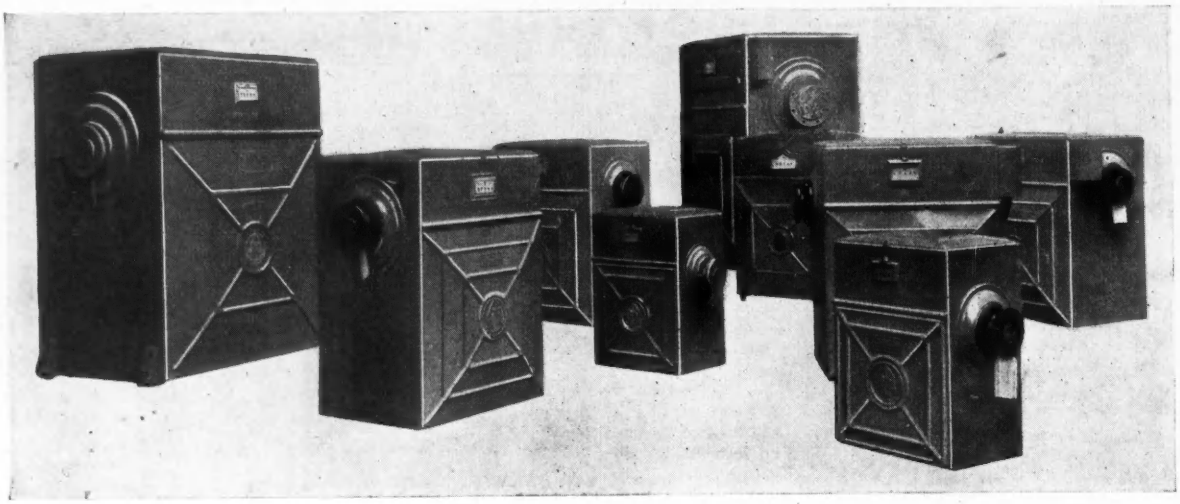

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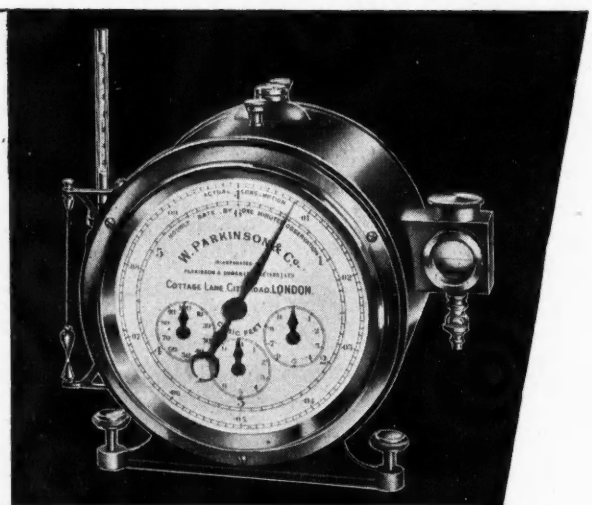

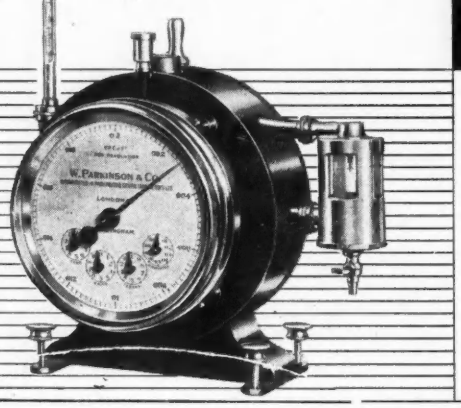

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THE SOCIETY OF BRITISH GAS INDUSTRIES 1905

P. 4

GAS JOURNAL, AUGUST 20, 1941

VOL. 235 93rd YEAR No. 4083

EDITORIAL NOTES

THE GAS RESEARCH BOARD

AN important announcement concerning the Gas Research Board appeared in our columns last week. It was to the effect that the Board had just received from the Registrar of Companies its official Certificate of Incorporation under the Companies Act, 1929, and had thereby acquired legal status. The Council—comprising nine members appointed by The Institution of Gas Engineers, six members appointed by the Society of British Gas Industries, and up to five co-opted members—is now proceeding with the election of members in accordance with the Memorandum and Articles of Association. Incorporation was, of course, a logical step ; whenever the time is opportune—and it would appear that for several reasons, among them availability in prevailing circumstances of personnel and materials, the present is not a good time in this regard—it is in a position to approach the Department of Scientific and Industrial Research for a grant. Should financial and other aid be given, the D.S.I.R. would be entitled to appoint two representatives to serve on the Council of the Board. Incorporation, in brief, puts the Board on a sound footing.

The war came at a time when the Industry, after many—some thought too many—years of effort, had evolved a more comprehensive organization for research. It arose as a development and extension of the research work hitherto directed and controlled by The Institution of Gas Engineers—the third major national association to spring from this ever-virile body. It was a co-ordinated scheme embracing all the interests concerned, and rightly bringing within its ambit representation and active support of the manufacturers of gas-making plant and gas distributing and consuming equipment. It was a plan of promise, and we think we are right in saying that in the event this promise has been fulfilled. It has aided the fusion of interests and has already, in wartime, done much good work of immediate national importance. Inevitably there had to be modifications of the programme of long-term research of a fundamental nature; but the Gas Research Board has, on questions of research, been able to speak for the Industry as a whole rather than for any one section of it. Its incorporation should bring added force to this unity of voice and should widen the scope and add to the prestige of Gas Industry research.

The objects of the Gas Research Board are well known. They were set out clearly in the first annual report of the Council which we published in full in the "JOURNAL" of Dec. 4, 1940. Its formation arose primarily from the desirability of the closer collaboration in research of which we have spoken between the supply side of the Gas Industry and the manufacturers of plant and appliances, and in order that, when the time was considered appropriate, financial assistance might be sought from the D.S.I.R. Membership of the Board consists of Ordinary Members, comprising British subjects and British Corporations carrying on business or otherwise engaged in the Gas Industry, and Associate Members, comprising, with certain restrictions, members of any class of The Institution of Gas Engineers or other scientific workers or persons engaged in or connected with the Gas Industry or likely to assist in its development. The importance and value of the Gas Industry's keeping closely in touch with research work undertaken by any association whose objects include scientific or industrial research in connexion with or of interest to the Industry has been stressed by us on several occasions. The Gas Research Board's incorporation ought to strengthen this association and co-operation. It is intended that all members of the Board shall receive from time to time confidential reports of the progress of its investigations and they will be able, in addition, to suggest to the Council new lines of research and to avail themselves of the facilities afforded by the Board in regard to technical enquiries. A Gas Industry Bureau of Information is undoubtedly needed. Its establishment is one of the aims of the Board, the activities and authority of which should grow rapidly and to great effect after the war.

SPECIALIZATION AND APPLICATION

THE discussion on the Papers at the Institution meeting brought out the need for future working in large, geographically well disposed, and interconnected units. It re-emphasized the need for the smaller undertakings having at their disposal expert advice on manufacture, distribution, domestic and industrial sales and service, and publicity. The future will, in fact, witness the increasing importance of specialization, both on the administrative and the technical side. For example, many small undertakings are situated in areas where a considerable industrial load could be obtained. Under present conditions of administration these undertakings have their activities limited; as members of an interconnected group and able to draw upon supplies of gas to meet the load and expert help to gain it, the position would be quite different, as has been proved in many instances already under grouped working. Again, pre-war local areas will not be found adequate to meet post-war conditions. Experience over recent years has shown great advances in output of small works as a result of linking up with larger modern works. Better and more constant gas quality and pressure, better technical and sales services, and better price policies have had their inevitable result. Examples were given at the meeting and in the discussion on the Symposium of the success of centralization and "grid" supply. One of them concerned a branch station of a group which was approached for an industrial load which would more than double its output, and the supply was required within a period of 8 to 10 weeks. All question of extension of plant was ruled out by both time and cost factors; but, being a member of a group, and being able to call upon technical help and advice, the result was that a satisfactory supply was afforded within the time limit at a price satisfactory to both parties. It would have been impossible for the small undertaking concerned to consider the supply while working on its old isolated basis. As it was, not only did the undertaking benefit, but the business transacted added to the prestige of the Gas Industry as a whole.

This evidences the growing importance of the application of specialized talent; and looking to the future Mr. F. C. Briggs, who has done so much on the educational side of the Industry, suggested—and he was speaking of management and administration—that the Institution will have to decide whether its Education Scheme, to meet specialization, must be widened and diversified and made even more elastic than it is now. The Institution, he said, will have to decide whether it is going to provide instruction in technical matters only or instruction to meet every branch of the Industry. His own feeling is that it should be confined to technical matters, and here we are inclined to agree. There arises a danger of lack of breadth if, for instance, a managerial course of instruction was devised by gas men. At the same time, he added, the higher administrator of our highly technical Industry must not be entirely divorced from technical knowledge. In other words, there must be a specialist engineer and there must be a specialist administrator. And there must be a link between the administrator and the Insti-

tution. From which it follows that the administrator should preferably have a technical background.

We have discussed before now the advantages and limitations of specialization—limitations not necessarily to the individual, but to the Industry in the application of the findings of specialist research. How often have we seen the fruits of research work unenjoyed. Unless the advice of the specialist can be followed up and maintained in practice by what we may term the operator, it will not be of very much avail. Behind all this specialization must be well trained staff receptive of ideas and able to comprehend what the specialist is saying. Without question, the Gas Industry has suffered very greatly from lack of interpretation of scientific research to works practice. One of the prominent examples of this lack of co-ordination which comes to our mind immediately is the work of Dr. F. J. Dent on the water gas process; for some time it was merely a question of good work largely wasted. Now Mr. John Terrace, in his Institution Paper, expressed the opinion that those for the higher positions in the Industry should, after receiving the most liberal education available at their schools, proceed to a university for a degree in science, commerce, or arts. Mr. J. H. Dyde argued that the Gas Industry should offer pupilages to young men of outstanding ability who have graduated in natural sciences or arts at one or other of our great seats of learning and culture. The actual course studied, he said, is not so important a factor, provided that personality and ability are present and the graduate has been known to make full use of the corporate life of the university. A two-years' pupilage would give the trainee an insight into the working and general organization of the Industry and would enable the governing body in the Industry to assess his aptitude for further development; if this be good, he should be sent to Leeds University for his final and special training in gas engineering to the University's Diploma standard. During his pupilage and advanced training he should be in receipt of an adequate allowance to cover his living expenses.

This is a pleasant idea, but it presupposes a great deal—that after the war there will be a ready influx of young men into the universities. Unless there is a drastic alteration of educational regulations and facilities we cannot think there will be this ready influx. High income tax and liberal education on the present basis are the unhappiest of bedfellows. And in any case we have yet to be convinced that university life and training are essential to the would-be executive in the Gas Industry or in any other industry.

The future will mean more specialization and a higher general standard of education of those engaged in understanding and carrying into effect the specialist's commands and advice. To our mind the Gas Industry will be sadly mistaken if it expects a high standard of education, both theoretical and practical, to be attained generally by students engaged in the Industry in the daytime and acquiring at any rate the theoretical part of their knowledge in their spare time in the evenings. "Education for education's sake," said Mr. Briggs, "cannot be considered as applying to the Gas Industry." With which sentiment we are in accord. It would be of little use if a would-be gas-works superintendent mistook a condenser tube for a flute or spent his time writing blank verse on the walls of the stokers' messroom. What is wanted is a review of evening instruction, and part-time day instructional courses free from overloading of irrelevant subjects. Which brings us to the report of the Board of Examiners of the Institution Education Scheme on the results of this year's examinations. Both report and results were published in our issue last week. It will have been seen that the number of candidates presenting themselves was much lower than in previous years. This, of course, was inevitable, but what is disquieting is that the standard of the candidates generally was lower than in previous years—no doubt partly accounted for by the difficulties of study under wartime conditions. Yet, more and more shall we need trained men to interpret the advice of the specialist, and every encouragement should be given so that after the war there will not be a wide gap in the supply of such trained men.

Autumn Research Meeting

The Council of The Institution of Gas Engineers has decided that, this year again, circumstances do not justify the convening of an Autumn Research Meeting of the Institution. Notice of Reports of Committees and Contributed Papers, which will be published and made available to members in the usual way, will be circulated in due course.

Planning for the Future

Well laid plans now will help gas to obtain a much wider field of use after the war, and it is obviously of the greatest importance that the Gas Industry should keep fully in touch with architects and fully conversant with new ideas on post-war building and civic development. It was therefore very encouraging indeed to see so many representatives of the Industry present at an informal meeting of the Town and Country Planning Association last Thursday, to launch the Association's new pamphlets and *Town and Country Planning* by Gilbert and Elizabeth Glen McAllister. Gas has a big part to play in the future in raising the standard of living and freeing our towns and cities from smoke.

Transformation

We reproduce on the left a photograph which we published in the "JOURNAL" of April 3, 1940, of the 10 acres surrounding the works of Ascot Gas Water Heaters, Ltd., being transformed by the united efforts of the employees from a wilderness to allotments. How the employees have since reaped the reward of their labour can be seen in the photograph on the right showing part of the cultivated area. The bed of over 600 onions is but a part of one man's second harvest from this onetime "waste" ground.

Personal

Mr. R. C. EVANS has been appointed General Manager, Mr. J. I. CRANE has been appointed Secretary, and Mr. L. G. LECKIE has been appointed Assistant Secretary to the Metropolitan Gas Company of Melbourne. Mr. C. F. BROADHEAD has resigned the Engineership, having been appointed Managing Director to the Colonial Gas Association, but will act as Consulting Engineer.

* * *

It is with regret we learn of the retirement, through ill-health, of Mr. E. P. STEVENSON, the Consulting Engineer of the Primitiva Gas Company of Buenos Aires, Ltd. Formerly the Chief Engineer and General Manager of the Company in Buenos Aires, Mr. Stevenson, since his return to Great Britain in 1930, has held the position of Technical Adviser and Consulting Engineer to the Board in London. His services in Buenos Aires date from 1902, but were broken by fourteen years' service with the gas undertakings in Rio de Janeiro and Milan.

Obituary

Mr. GEORGE MARTIN, General Manager and Secretary of the Davis Gas Stove Co., Ltd., Luton (Radiation Ltd.), died on Aug. 6 after an illness of seven and a half months.

Born in 1891, Mr. Martin was educated at the Glasgow High School. He was a member by examination of the Chartered Institute of Secretaries and of the Institute of Cost and Works Accountants. His wide experience included the post of chief statistician of the Disposal Board of the Ministry of Munitions in 1919, and previously that of chief accountant to a British factory in France engaged in the manufacture of tanks for the Western Front in the last war.

He joined the Davis Gas Stove Co. in July, 1935, as Secretary and Chief Accountant, and he was appointed General Manager of the Luton Works only a few weeks before his last illness. He represented the Davis Company at the Luton Chamber of Commerce and on the Luton War Savings Council.

A memorial service was held at St. Saviour's Church, St. Albans, on Aug. 9. The large attendance of representatives of the firm, including Mr. Kenneth N. Davis (Managing Director of the Davis Gas Stove Co.) with Mrs. Davis, attested the esteem, respect, and affection in which Mr. Martin had been held.

National Gas Council

Meeting of Central Executive Board

A Meeting of the Central Executive Board of the National Gas Council was held at Gas Industry House on Tuesday, Aug. 12, at 1 p.m. Sir DAVID MILNE-WATSON, Bart., LL.D., D.L., Chairman of the Board, presided.

Coal.—The Board received a verbal report from their representatives, Mr. S. Tagg and Lt.-Col. Bywater, who are the gas representatives on the Public Utilities Coal Committee which was set up by the President of the Board of Trade under the Presidency of Mr. J. C. Dalton. A long discussion ensued during which reports were received from various parts of the country dealing with the problems involved.

The thanks of the Board were expressed to Mr. Tagg and Lt.-Col. Bywater for the work which they had done in connexion with this matter and they were asked by the Board to continue their efforts.

War Damage.—Resolutions passed at a meeting of the Yorkshire (West Riding) District Executive Board dealing with this matter were submitted and considered by the Board. A further meeting of the War Damage Committee of the Council, followed by a meeting of the Sub-Committee of the Emergency Committee of the Conjoint Conference of Public Utility Associations, held on July 16, were reported, when it was decided to seek an interview with the Treasury in order to obtain an interpretation of certain statements in a letter received from the Treasury. After discussion agreement was reached with regard to the method of apportionment.

Leakproof Tube Joints

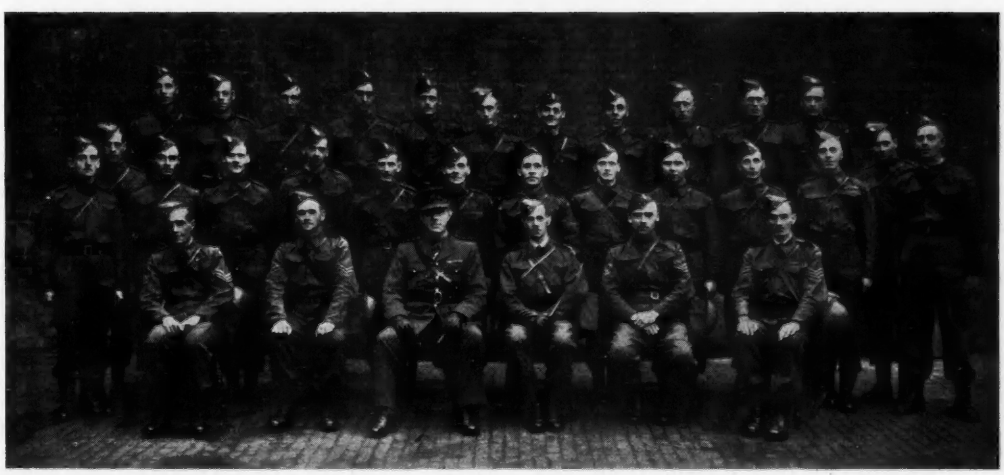
Ascot Gas Water Heaters, Ltd., and F. R. Williams have been granted a patent (No. 536,158 ; application date, Feb. 9, 1940) relating to improved methods of forming leakproof joints. The patent has particular application to the spigot or nipple and union joints used in connecting the tubes of water heater boilers where the joints are subjected to extreme temperatures during the operation of the apparatus. In spigot joints for the tubes of water heaters it has been usual to braze a union on one tube to receive a nipple on the tube to be joined thereto and one of the objects of the present invention is to avoid the brazing of the union.

According to the invention the tube to receive the union is fitted into a flanged opening in the required plate, frame, or other part of the apparatus, so that the tube projects above the plate, the flanges making a close fit with the projecting part of the tube. A union is then slipped over the projecting end of the tube so that its base rests on the plate, the tube projecting beyond the upper face of the union. The base of the union is recessed to accommodate the upstanding flanges round the opening in the plate and to form a chamber round it. Slots are cut in the sides of the base of the union communicating with the chamber, such slots preferably being radial and the upper face or end of the union being preferably serrated or notched.

To secure the union to the tube, the projecting end of the latter is spun over the serrated face of the union to make a tight joint therewith and solder or other suitable molten metal is then run into the chamber at the base of the union, the air escaping through the slots. The whole may then be dipped in solder or in a bath of suitable molten metal if desired. The union is firmly secured to the tube without the necessity of a brazing operation, which is a great advantage in practice. To assemble the joint the nipple on the tube to be joined is inserted into the union with a suitable fibre or other washer inserted between the shoulder on the nipple and the upper end of the union as usual and a locking or clamping nut is screwed over the nipple and union to draw the two together. The tightening of the nut compresses the nipple, the fibre washer, the spun end of the mating tube, and the serrated face of the union, ensuring a tight and leakproof connexion, all the mating surfaces of which are substantially under equal and even pressure.

In the article by Mr. Norman B. Biggs on Nitrogenous Gum, published in the "JOURNAL" of Aug. 6, p. 213, the formula for potassium di-nitrosylsulphide was given as $K(Fe(NO)_2S)_2\ H_2O$. It should read: $K(Fe(NO)_2S)\ 2H_2O$.

A Winning Platoon



On certain ground in Wednesbury on Sunday, July 27, there was much unusual activity. Battles were going on all day long, platoons of the Home Guard attacking and mopping up enemy parachute troops. It was the final test in a competition for a Cup presented by Colonel S. J. Thompson, late Commanding Officer of the Zone, for the best platoon in the No. 3 Group South Staffordshire Zone of the Home Guard for work in actual battle practice attacking an enemy position. The final was won by a team of men all engaged at a local Works, from No. 4 Platoon (commanded by Lt. F. C. Briggs) "A" Company of the 3rd Worcestershire (Dudley) Home Guard (Commander, Lt.-Colonel A. R. Tanfield). The Battalion was very proud to have won the first Cup of this kind that had been open for competition in the district. Above is a photograph of the team with the Battalion Adjutant, Captain A. V. Rogers, and the Platoon Commander, Lt. F. C. Briggs.

EFFECT OF THE CORRECTION OF GAS VOLUMES ON GAS DELIVERED FIGURES*

By J. GASKARTH, B.Sc., *Liverpool Gas Company*

ALTHOUGH it is very likely that the majority of undertakings have accepted the principle of correction of gas volumes to standard temperature and pressure, it is to be regretted that the first official pronouncement on the matter made by the Institution was specialized by being made by the Sub-Committee on Unaccounted-for Gas. It is felt that this may have left the impression that the correction of gas volumes has its only effect in adjustments in the unaccounted-for gas figures calculated yearly.

In truth the effect is so much wider that it is obvious that the only true comparison of any gas volume figures, from day to day, month to month, and year to year, can be effected if these figures are rendered independent of such variations in temperature, gas pressure, and atmospheric pressure as undoubtedly must occur from day to day, month to month, and year to year.

If this truth required any ventilation, the Liverpool Gas Company is favourably placed, because records have been kept of delivery figures in duplicate. The first of these is corrected for meter temperature only, by an empirical formula, and the second is fully corrected to standard temperature and pressure using the recommendations of the Sub-Committee for unaccounted-for gas as laid down in Communication No. 194, November, 1938, of the Institution. As records of daily barometric averages have also been kept it is thus possible to note the extent of the effect of this one variable on delivery figures. I am indebted to Mr. Astbury, the Chief Engineer, for permission to use these records and to make the results available in this way.

During the years 1939 and 1940 direct comparisons between the figures were made daily, and these comparisons indicated that the difference between corrected figures and figures uncorrected for barometer (hereafter called uncorrected figures) was not a constant but a variable dependent on the barometric average for the period.

Example.—On Feb. 14, 1939, with a high barometer of 30.47 in. the corrected figure was 3.55% higher than the uncorrected, and in the same way, July 11 and November 21, days with high barometer averages of 30.21 in. and 30.55 in., the corrected delivery figures were 2.58% and 3.65% higher than the uncorrected figures. On the contrary on Jan. 15 and May 5, when the barometer averages were very low, being 28.82 in. and 29.43 in. respectively, the corrected figures were 0.71% and 0.57% lower than the uncorrected figures. Hence the expected result is found that the uncorrected figures are lower or higher than the corrected figures by percentage amounts directly dependent on the variation of the atmospheric pressure from 30.00 in.

The half-yearly and yearly results for the two years further illustrate this fact, as in 1939 the two half-yearly barometer averages were constant at 30.26 in., and the corrected delivery figure remained constant at 2.0% higher than the uncorrected figure. In 1940, however, the barometer average was 30.30 in. in the first half year and 30.26 in. in the second half year, and the percentage difference between corrected and uncorrected figures changed from 2.5% to 2.2%. The difference between the yearly figures corrected and uncorrected was 2.35%, the exact mean of the two half-yearly figures, thus confirming the fact that the divergence is almost exactly dependent on the variation of the barometer from 30.00 in.

In comparing results for one year with the equivalent period of the previous year, the necessity of reducing all gas volumes to standard temperature and pressure is even greater. Comparing day by day results for 1940 with the equivalent day of 1939, it was found, for example, that on Jan. 14 there was a variation from a lower delivery in 1940 of 3.45% using uncorrected figures to an increase in delivery of 0.72% when corrected figures were used, this +4.17% total difference corrected to uncorrected being due to a barometric pressure difference between the years of +1.60 in. In fact during the first two months of the two years the divergence between percentage differences correct to uncorrected of daily figures varied from +4.17% with a barometer variation of +1.60% to −1.95% with a barometer variation of −0.73%.

The comparison of half yearly and yearly figures between the two years shows the same general rule. For the first half year 1940 compared to 1939 the difference between corrected and uncorrected figures was +0.13% with a barometer difference of +0.04 in. For the second half year 1940 compared to 1939 the difference was −0.15% with a barometer variation of zero. For the years the difference was −0.03% with a barometer variation of +0.02 in.

It is thus established that, as figures corrected to standard temperature and pressure can be taken as standard, figures uncorrected for barometric pressures vary from the standard by amounts dependent on the variation of the barometric average from 30.00 in. It will also be noted that figures uncorrected for meter pressure vary from the standard in the same way, but to a much smaller degree. (For example even with a barometer divergence of zero there was a percentage variation from year to year of −0.15%.)

Thus figures completely uncorrected will be effected by these independent variables, those two, barometric pressure and meter temperature, having a decided effect; and the third, meter pressure, a smaller, more constant effect. There is, therefore, no basis of comparison of gas volume figures unless they are all resolved to standard conditions of temperature and pressure.

It will further be noted that comparisons of uncorrected delivery figures will lead to completely false conclusions, as atmospheric variables will have the double effect of altering the volumes measured and also of varying the public's demand for gas.

* Paper to the Manchester and District Junior Gas Association.

Discussion

Mr. **J. C. Hogg** (Stretford) enquired if the correction that had been applied to gas makes had substantially altered the figure for unaccounted-for gas. To what extent did the meter temperature vary? The application of such corrections depended upon the limits of accuracy which were being adopted—*i.e.*, if the meter temperature varied to a very wide extent the relative importance of the meter pressure would be much diminished, and could possibly be ignored. Alternatively, if the meter temperature was fairly constant the relative importance of the meter pressure became greater. What method was used at Liverpool for determining the average pressure and temperature of the gas? The advantage of having a recorder chart driven from the meter would be obvious, as, for example, the Connersville P.V. T.T. recorder. Did not the figures submitted by the Author prove $\frac{PV}{T}$ = the constant? It appeared as though the divergencies due to meter pressure and temperature were merely a form of alteration in the gas volume following $\frac{PV}{T}$.

Mr. **Gaskarth,** in reply, said that the reason he did not refer to unaccounted-for gas figures was because it was a question of such far-reaching importance that he did not wish to be accused of specializing. With regard to $\frac{PV}{T}$ = the constant, he had some unaccounted-for gas figures and found the variation only slight at first, but it became very evident when dealing with large quantities of gas. In 1939 the uncorrected figure was 5.55% for unaccounted-for gas, while the corrected figure was 4.90%, which was a difference of 0.65%. This was an annual figure, so that there was a difference of 40,500,000 cu.ft. of gas. He agreed that a considerable amount of work remained to be done in establishing greater accuracy by means of proportionate representation. Actually an arithmetical mean was taken and this had been sufficient to prove the case put forward. A recording method connected with the meters would improve the technique.

Mr. **H. Platt** (President) was of the opinion that a basis should be established whereby comparisons could be made from year to year. The unaccounted-for gas did not affect the receipts, which were based on the consumer's meter. Had Mr. Gaskarth any figures with regard to the effect of temperature and pressure upon a consumer's meter? At certain times gas was made and put into stock and gas was sold which was measured and corrected to those figures. Gas in stock would be sold some days later, and the gas would be sold at a different temperature and pressure.

Mr. **Gaskarth** replied that difficulty was experienced in deciding what quantity of gas was in a holder and what was its temperature and pressure. When the stock of gas was taken at the end of the day or even during the day, the difference was due to expansion. He stated that The Institution of Gas Engineers had not made sufficient recommendations for the scientific "tightening" of the calculations of gas volume.

Mr. **J. Albinson** (Manchester) expressed the opinion that holder pressure should always be taken into consideration, otherwise results between various works would not be comparable. In fairness to the distribution engineer, the temperature and pressure at the consumer's meter should be taken into consideration, so that a corresponding set-off could be made against the holder pressure.

Mr. **Gaskarth** remarked that the unaccounted-for gas figures were corrected in accordance with the I.G.E.'s recommendation on an adjustment of the temperature of the gas in the mains at various times of the year, and a barometer reading obtained from the nearest observatory. A greater increase was shown by the correction to standard temperature and pressure. He had not intended to speak on unaccounted-for gas, because the subject had a much wider application than was warranted by the Paper itself.

Mr. **E. B. Fields** (Blackburn) said that gas engineers were scientific in thought, but not always in action. He thought correction of gas volumes had been given an exaggerated importance. Some months ago a large baking oven was installed and the meter was placed in close proximity to the oven, where, of course, the temperature was high. The consumer raised the point that he would be paying more for the gas he was burning because the temperature of the gas had been raised, and it was quite a time before he could be persuaded that the difference was negligible in his case. Where thousands of consumers were concerned, the difference was, of course, an important matter. He thought sufficient stress had not been laid upon the use of governors. In his district, the pressure varied from 8 in. W.G. down to 3 in. W.G., and they found that when governors had been installed they well repaid the cost.

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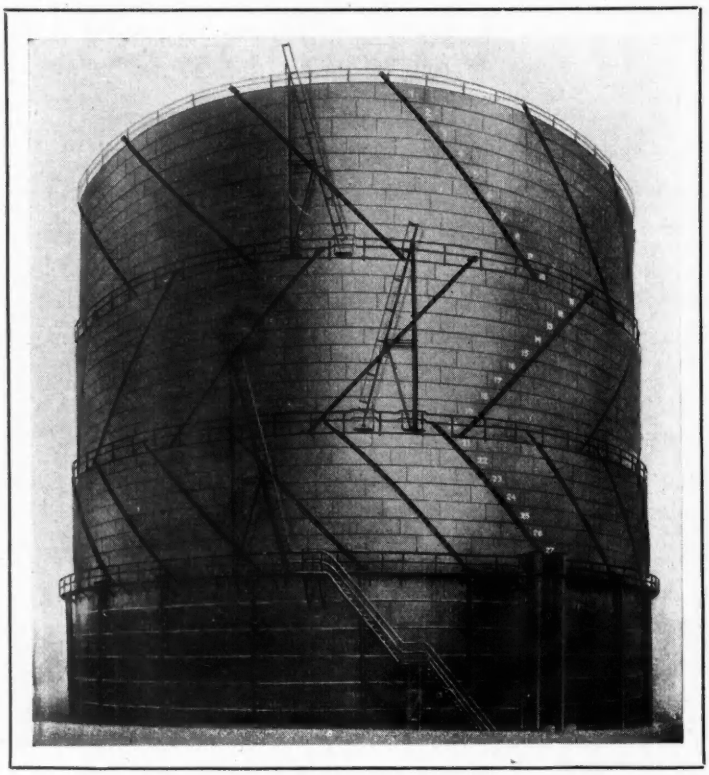

STEEL TANK ...	...	...	... 149 ft. 7½ ins. dia., 33 ft. 2 ins. deep
INNER LIFT ...	...	...	... 141 ft. 6 ins. dia., 32 ft. 6 ins. deep
MIDDLE LIFT...	...	...	... 144 ft. 6 ins. dia., 32 ft. 6 ins. deep
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Mr. **J. Graham** confirmed that the installation of service governors was a matter for serious consideration. A meter was tested at 2 in. pressure, and if gas was being supplied at 4 in. pressure, then there was an increase in unaccounted-for gas.

Mr. **Platt** said that if by installing district governors there was likely to be any monetary saving, then governors should be installed, but there was not sufficient available knowledge to warrant the cost of installing governors in every works or house.

Mr. **Albinson** mentioned that in the latest regulation for the measurement of calorific values there was a definite correction section for the actual pressure of the gas in the meter. The calorific value could be measured with greater accuracy.

GAS AND THE SMOKE PROBLEM*

By W. L. JONES,
St. Louis County Gas Company, and
F. E. VANDAVEER,
American Gas Association Testing Laboratories, Cleveland.

DENSE concentrations of industry and population make of smoke a nuisance long uncontrolled but accepted as a by-product of industrial virility and modern urban life. Smoke pouring from factory stacks, a symbol of throbbing machinery, smoke wisping from workers' homes, promising warmth and security, becomes, when its sources are multiplied a thousandfold, a vicious destroyer of civic beauty, public health, and property. Smoke arising from a hundred towers of inefficiency and waste merges over a community to strike again at the citizens' purses, and to undermine their mental and physical well-being.

The smoke problem is a real one. Probably its worst aspect is its effect on health. This relation is difficult to evaluate. As in other crusades, the evils of this public problem have in many instances been overstressed. In order to discuss with reasonable accuracy the effect of smoke on health, it is first necessary that the true nature of the former be well understood. Smoke is popularly supposed to be nothing more or less than particles of carbon and other tarry substances. This is a natural conclusion, since these constituents of smoke render it visible. Such carbon particles are produced by inefficient combustion of bituminous coal. These wasteful methods can be corrected by proper firing, and this aspect—the liberation of visible "dirty" smoke—can be eliminated without conversion to more refined fuels. But smoke is not a simple substance. Bituminous coal generally has an appreciable sulphur content. A reasonable average value may be taken as 2%. Thus, a ton of coal when burned will produce some 60 lb. of sulphur oxides which, since they are liberated in gaseous form, occupy a volume of nearly 700 cu.ft. This invisible, and possibly one of the most vicious elements of smoke, is seldom considered. Yet in 1930, 65 people were killed in the Upper Meuse district of Belgium by "smoke" from factory stacks, the fatal gas being identified as a sulphur compound. Conditions for this disaster represented a unique combination of barometric pressure, wind, temperature, fog, and topographical surroundings which may never again be duplicated. However, it graphically illustrates an acute case of conditions normally and continually surrounding every industrial centre.

Another nearly invisible constituent of smoke is silica, the deadly and widely publicized killer in certain mining and industrial operations. Also may be mentioned the presence of arsenic, manganese, iron, and other allotropic and polyvalent substances resulting from industrial processes, all of which may have a deleterious effect directly or through catalytic action.

Smoke must therefore be considered in its true light as a complex heterogeneous mixture containing more than one substance harmful to health. It is no wonder, then, that estimates of the baneful influence of smoke on human life by responsible physicians and health officers vary so widely. It has been said that a prolonged smoke fog lasting several days will kill more people than automobiles do in that area in many months. Correlation of smoke and high incidence of pneumonia seems to have been clearly established. More conservative experts point out that such relations between cause and effect have not yet been irrefutably established, largely because of lack of fundamental data on physiological reactions to the substances involved. However, boundless evidence exists that death rates from pneumonia and other respiratory ailments are greater in smoky industrial centres than in small urban communities. The effect of smoke in depriving people of sunlight is another broad aspect of the smoke problem, and one which probably has an important bearing on health.

Economic Aspect

The admittedly huge toll of smoke from a monetary standpoint is as difficult to evaluate as from a health viewpoint. It has been estimated that the annual bill for wastage of fuel due largely to incomplete combustion resulting in smoke and soot is $200,000,000. When cleaning of buildings, laundering or dry cleaning of wearing apparel and house furnishings, the shortened life of such articles due to frequent cleaning and other items are considered, the total cost of smoke mounts to a staggering figure. An estimate for this complete total has been given as $2,500,000,000 annually.

Production of smoke in any given community may, for convenient analysis of the problem, be segregated into four principal classifications—industrial, commercial, railroad, and residential. The proportion of total smoke which may emanate from any one of these principal sources will be dependent on the industrial activity of the community, the types of fuels in common usage, climatic conditions, and other factors. Similarly, the relations between total production of smoke or production of smoke from each source and its nuisance value are variable for different communities, being influenced materially by metereorological conditions, density of population, and related conditions. It, therefore, becomes difficult to attempt to state generalities which may be applicable with any reasonable degree of accuracy to a given community. It seems preferable, on the contrary, to select specific cases in order to illustrate typical and significant aspects of the smoke problem which have a counterpart to a greater or lesser degree in any given situation.

One of the most comprehensive and accurate investigations of smoke production and abatement was that made in Salt Lake City by Gudmundsen. Table I was taken from his paper; it presents conditions at the beginning of what the author terms the "first real step" in smoke abatement in Salt Lake City, initiated by an investigation of the problem in the heating season of 1919–20. Apparently at least six previous and active smoke-abatement campaigns had been made in this community between 1890 and 1920. It is significant that the percentage of smoke produced by industrial and large heating plants is relatively greater than the proportion of coal burned in those processes. Conversely, residences used slightly over 40% of the coal but produced only about one-fifth of the total smoke. Ten years later (1930) the smoke from industrial plants in Salt Lake City had been decreased by 90%, and indicates the tremendous progress which can be made in this direction by improved coal-firing methods and equipment. At the end of this ten-year period residential smoke accounted for 85% of the total, because of the tremendous decrease in smoke from industrial sources and the increase in the number of residences. Gudmundsen concluded that "after ten years of activity in smoke abatement and in spite of the substantial reduction effected, Salt Lake City still has a serious smoke problem," and further that "permanent relief will depend on complete elimination of residence smoke." He also indicated that Salt Lake City would still have an aggravated smoke nuisance as long as soft coal is used for domestic heating, and that nothing less than elimination of this type of fuel will ever solve the problem.

From this typical case the magnitude and complexities of the smoke abatement problem become evident, to say nothing of the obstacles which must be overcome to bring about its permanent solution. Another aspect of this situation is also illustrated by data on the Salt Lake City case. After several years of intensive campaigning, active abatement work was temporarily discontinued in 1925 and the increase in smoke production was sharp and noticeable. Evidently a continuous and alert campaign must be maintained to effect a partial correction of the smoke nuisance if the use of soft coals is to be continued.

More recently St. Louis, with a smoke problem estimated to cost $19,000,000 annually, has made conspicuous headway in reducing visible smoke. No accurate data were available showing the amount of smoke produced by the different classes of consumers. The Joint Council of the Associated Engineering Societies of St. Louis in a report on the subject said: "It is unnecessary to argue the point as to whether the smoke problem is created by our industrial plants, our railroads, our large heating plants, or our domestic fires. It is obvious that each class contributes to the pollution of the air." A plan for smoke elimination was founded on two cardinal principles. All those who desire to burn high-volatile fuel must employ mechanical fuel-burning equipment to burn it smokelessly; if they do not desire to use mechanical fuel-burning equipment, they must use a smokeless fuel.

TABLE I.—COAL CONSUMPTION AND SMOKE PRODUCED BY DIFFERENT CLASSES OF CONSUMERS IN SALT LAKE CITY DURING THE WINTER MONTHS OF 1919–20.

Consumer.	Coal, Tons.	Coal, %.	Smoke, %.
Industrial and large heating plants ...	176,492	34.3	44.58
Small heating plants	41,981	8.1	9.04
Railroads	53,140	10.3	18.38
Residences	210,000	41.0	21.83
Miscellaneous	31,589	6.3	6.17
Total	513,202	100.0	100.00

Consumption in 1930, Tons.

Domestic	300,000
Industrial and all other ...	400,000
Total	700,000

These and other recommendations were enacted into law, and stringent enforcement was provided. That this has greatly reduced visible smoke in St. Louis is shown by the report of the Weather

* From a Paper published in *Industrial and Engineering Chemistry.*

Bureau showing that the duration of smoke was reduced 64% for the first five months of the 1940–41 heating season as compared to the corresponding period of the preceding season. Divided by months, the duration of smoke was as follows:

	1939-40.				1940-41.			
	Thick.		Moderate.		Thick.		Moderate.	
	Hr.	*Min.*	*Hr.*	*Min.*	*Hr.*	*Min.*	*Hr.*	*Min.*
Sept. ...	...	...	6	15	4	45*a*	4	15*a*
Oct. ...	2	45	6	45	8	00*a*	1	05*a*
Nov. ...	34	15	39	15	0	30	40	25
Dec. ...	40	10	62	35	0	50	56	35
Jan. ...	26	00	226	00	1	15	29	58

a Probably caused by fuel carried over from the preceding season.

In the St. Louis metropolitan area gas now plays a large part, and is destined to be even more important in the smoke elimination programme by providing a fuel that complies fully with the second cardinal principle laid down by the Smoke Elimination Committee—it is truly smokeless. Although the smoke ordinance that has done so much to clear the atmosphere in St. Louis does not yet apply to much of the suburban area adjacent to St. Louis, gas how heats 20 to 30% of the homes throughout a considerable portion of this suburban area. It now seems likely that legislation will soon be enacted in these areas to curb the use of smoke-producing fuels.

Of the 20 million odd residences in urban communities, approximately 17 million are supplied with gas service. Of these, over 10 million are supplied with manufactured gas, a refined product of coal or oil or both, and 7 million with natural gas. In other words, about 17 million American families cook with gas, which in itself is an important contribution to smoke abatement. The homes of nearly 800,000 families are heated by central heating systems fired by gas. An additional 1,800,000 dwellings are warmed by gas room heaters and floor furnaces, making a total of 2,600,000 urban homes gaining their winter comfort from gas, or roughly 10% of the total. To provide gas heating for the other 90% of the homes is a major task. The universal use of gas as the complete and only permanent solution of the smoke problem, while feasible over a period of years, obviously cannot be brought about overnight. While such a solution is sound economically, a number of authorities have attempted to prove the contrary. For example, one qualified investigator stated not many years ago that, while gas for residential heating was the only answer to the smoke problem, not even the most optimistic observer could hope for a situation to arise overnight where a majority (60%) of our people would heat with natural gas since "people cannot be induced to spend the money necessary to accomplish this." How times change! Last year, in territories served by gas utilities (all large urban communities), 62% of all new homes constructed included gas for heating. In natural gas territories this proportion of gas heating is as high as 90% even where winters are severe (estimated for Cleveland, Ohio). Much of the new construction is in suburban areas and does not serve to alleviate conditions in older, more densely populated sections of a city. However, the trend is unmistakable, and eventually, it seems reasonable to hope, the smoke problem can be permanently solved by using gas predominantly for residential heating, coupled with careful control of those heating and industrial processes which must remain the field for crude fuels, at least for a considerable time in the future.

Comparison of Coal and Gas as Fuels

We propose to show by analysis that in due time universal use of gas is not only ideal aesthetically but is also practically and economically feasible. This analysis will involve manufactured gas produced from coal. Natural gas will not be considered since the practical and economic use of this fuel for all residential and industrial heating purposes is a matter of record and needs no proof. Furthermore, the widespread use of natural gas transmitted through pipe lines to communities far removed from gas fields has also proved itself; it makes any discussion of the economics of long-distance transmission unnecessary. No one doubts that major extensions of the 84,000 miles of natural gas pipe lines (over 270,000 miles including distribution lines in cities) carrying the ideal fuel from twenty-three producing states to a total of thirty-eight states and 32,000,000 people are in prospect.

This analysis will also neglect fuel oil, since this basic fuel has such a special form value for usages other than those competitive with gas or coal. Oil is the propellent of our Navy, and when it reaches "two-ocean" or "three-navy" stature the tremendous requirements from this direction alone can well be appreciated. The impending increase in our merchant marine will likewise make greater and greater demands on our oil supply. The nation's 25,000,000 plus automobiles can, in the light of present knowledge, be powered for the flexibility and cruising range considered necessary only by liquid fuels. With these vast requirements, for which oil is recognized to be most adaptable, coupled with the fact that oil reserves now have the shortest life expectancy of any basic energy form, can a fuel economy based to any extent on petroleum be envisaged? Could the more costly production of oil through hydrogenation of coal be condoned for use in transportation, when petroleum was being utilized in large quantities for heating and other processes for which coal or gas are equally or better fitted? Any smoke abatement programme based to any considerable extent on the use of oil for residential heating and industrial processes would seem shortsighted and doomed to failure.

In the future when oil reserves are conserved for appropriate uses the possibility that natural gas must be supplanted or augmented by manufactured gas must be considered. This latter alternative is now being followed in St. Louis, Chicago, and Washington, DC., where in each case natural gas transmitted long distances is mixed with locally manufactured gas prior to distribution.

In considering the comparative economics of coal and gas manufactured therefrom by conventional processes, a basic approach is desirable. Demski showed that a coal having an upper heating value of 14,040 B.Th.U. per lb. would yield the following energy equivalent by common coal carbonization and by-product methods:

Fuel.	Energy per Unit.	Total Energy.
8.0 cu.ft. of city gas ...	484 B.Th.U./cu.ft.	3,870 B.Th.U.
0.008 lb. benzene ...	17,300 B.Th.U./lb.	144 B.Th.U.
0.5 lb. coke	13,000 B.Th.U./lb.	6,480 B.Th.U.
0.042 lb. tar	16,200 B.Th.U./lb.	686 B.Th.U.
		11,180 B.Th.U.

This, therefore, represents an energy conversion of 11,180 ÷ 14,040, or approximately 80%. However, it does not reveal the whole truth, since the gas and coke produced by the carbonization process are refined fuels susceptible to higher utilization efficiencies. If it may be assumed that bituminous coal can be utilized with an efficiency of 50% (average of hand-firing and stoker methods), gas at 80%, and coke at 60%, the following heat balance becomes evident:

Raw coal: 14,040 × 0.5 = 7,020 B.Th.U. useful heat.
Gas: 3,870 × 0.8 = 3,096
Coke: 6,480 × 0.6 = 3,888
6,984 B.Th.U. useful heat.

It is obvious that on this true basis no sacrifice, from the standpoint of national economy, would be entailed by conversion of bituminous coal to gas for all heating purposes. This analysis has discounted the distribution losses for gas (not more than 5%), since no compensating allowance has been made for the energy content and economic value of the other carbonization by-products, such as benzene and tar.

The above figures, based on European practice, are corroborated in this country. Beebee makes the following tabulation:

Energy in fuel (coal)...	100%
Loss in conversion to gas	20
Energy left for distribution	80
Loss in transmission, conversion, and utilization ...	24
Heat utilized	56

Bearing in mind the reasonable assumption that coal is utilized for heating at an efficiency of 50%, this tabulation would indicate the over-all economics to be favourable to conversion of coal into gas. It might be argued without proper justification that coal could as economically be converted into electricity as into gas, owing to the high utilization efficiencies of electric energy. However, such is far from the case. Resorting again to Beebee's figures, the following comparison may be made:

	For Heat.	
	Gas.	Electricity.
Energy in fuel	100%	100%
Loss in conversion process	20	75
Energy left for distribution	80	25
Loss in transmission, conversion, and utilization	24	5
Heat utilized	56	20

This simple but accurate analysis shows why use of electricity for general heating purposes would represent an uneconomic process and an unjustifiable waste of natural resources. Our nation, regardless of its vast resources, would probably not countenance the use of a form of energy (electricity) which would require two and a half times the amount of basic fuel as does an equivalent amount of gas.

It is interesting to pursue this line of reasoning further. Demski developed his basic figures in a different manner, and showed a number of interesting relations which may be briefly summarized as follows. Each of these relations has the concept that equivalent amounts of the basic fuel (coal) and heating (not power or light) requirements are involved:

If the efficiency of a coal installation is 16% or higher, a loss of energy would be involved in using electricity even if its efficiency of utilization were 100%.

If a gas installation operates with an efficiency of 80%, no loss in basic energy is involved if a coal installation for the same requirements operated at an efficiency of less than 60%. (This would imply that gas can be used without sacrifice of basic energy, since it can under present practice be utilized at efficiencies of 80% for residential heating, where coal operates generally at less than 60%.)

The utilization efficiency of electricity would have to be 4.6 times that of a gas installation to avoid waste of basic fuel. (This is an obvious impossibility unless a commercial application can be made of the Kelvin cycle, which application would approach theoretical limits.)

It should not be implied from the foregoing that, since an over-all energy equivalence exists between coal and gas manufactured from coal (together with by-products), the consumer should be entitled to buy the same amount of energy in gas as in coal at the same price. Gas is a premium fuel, and a premium price is justified. It is cleaned and scrubbed during the manufacturing process to remove those noxious elements which in crude fuel constitute one of the chief dangers of smoke. Manufactured gas is conveyed under the thoroughfares of the community through an elaborate and expensive distribution network. It is delivered to the consumer's premises under controlled pressure 24 hours a day, his useful servant at the turn of a tap. Water in a natural lake costs nothing. Purified and delivered to the home, it is a relatively costly product, and rightfully so. So it is with gas.

(*Continued on p. 295*)

Future of Gas Utilization

However, the future may hold the secrets by which the form value of by-products of coal carbonization may be improved to a point that gas will become the by-product in an economic sense. The Gas Industry, as well as other interests, is expending a considerable sum in by-product research, in an endeavour to increase both the thermal efficiency of conversion and the value of by-products. It is not beyond the realm of probability that the gas plant of the future will be a chemical plant in the truest sense. Then the cost of manufactured gas with all its virtues may approach that of the basic fuel when delivered to the consumer. Thus, we may arrive at the Utopia of the idealist who envisages clean cities resulting from conversion of coal at the mine head, the shipment of by-products to chemical centres, and the transportation of gas to urban communities by pipeline, all without economic upheaval or unemployment.

Gas, either natural or manufactured, when utilized for home heating enjoys many advantages that tend to compensate for any price differential between it and crude fuels, and to earn its position as an ideal fuel. Automatic control resulting in uniform healthful control of room temperature, freedom from ash disposal, fuel handling, and storage, and cleanliness of premises are unique advantages. These, plus the elimination of smoke, contribute to community advancement.

An aspect of gas utilization seldom mentioned is the stability of price. It is not unlikely, in view of present world conditions, that the cost of coal and oil may skyrocket. Price of city gas, under regulation as to cost as well as purity, remains far more stable than that of practically any other commodity during periods of price inflation. Over a number of years, only gas of the three major heating fuels has decreased materially in cost, while others have increased.

Industrial processes profit considerably by the unique form value of city gases. Combustion of these gases not only produces heat economically under precise temperature control, as would be inferred from the basic analyses made, but its resultant products serve simultaneously to provide protective atmospheres for metal annealing without decarburizing or scaling, bright hardening, heat treating, carburizing, ceramic firing, and numerous other uses. In such cases the increased value and production rate of finished materials may entirely offset the total gaseous fuel costs. In other processes the use of gas for direct firing may, by eliminating bulky protective containers (such as saggers in ceramic firing) which are necessary with crude fuels, more than compensate for the cost differential between gas and the crude fuel. All these tangible, as well as the less obvious, advantages of gas for industrial heating purposes must be properly evaluated in arriving at a complete and accurate economic comparison between it and crude fuels. Specific cases require careful attention and analysis, and are of such detailed nature that space does not permit treatment of any one for illustrative purposes. However, these suggestions are indicative of the many factors which must be taken into account to arrive at a fair cost comparison of solid, liquid, and gaseous fuels.

Conclusions

1. A successful smoke abatement programme should envisage the eventual elimination of invisible as well as visible elements of smoke. The former include fly ash, sulphur compounds, and other so-called trace compounds emanating from certain industrial processes.
2. It seems apparent that production of smoke from industrial processes can be largely eliminated by an active and continuous programme. Smoke from residential heating plants seems less susceptible to control.
3. A complete and permanent solution to the smoke nuisance probably is contingent on the almost complete replacement of bituminous coal for residential heating, by gas, coke, and oil.
4. Natural gas transmitted to millions of residences in thirty-eight states through 84,000 miles of transmission lines and 187,000 miles of city distribution mains has proved its economic justification for heating purposes.
5. The known reserves of coal are probably inexhaustible at the present rate of consumption. Those of oil and natural gas are much more limited, the former undoubtedly having the lowest life expectancy of all three basic fuel forms.
6. Because of its limited reserves and inherent adaptability for air, water, and land transportation, oil should not be seriously considered for long-range smoke abatement programmes.
7. Natural and manufactured gases, the ideal smokeless fuels, can together ultimately fulfil all heating requirements without serious economic disarrangement or wastage of our natural resources.
8. After the depletion of natural gas (when and if this occurs), manufactured gas can, through appropriate coal gasification processes, bear the total national heating load alone.
9. Steam-generated electricity for heating purposes is uneconomic and an unjustifiable waste of natural basic fuel resources, except for special purposes to which it may be peculiarly adapted. (This does not apply to use of electricity for light and power.)
10. Hydroelectric power, if all potential sources are developed, is far from sufficient to meet total heat, light, and power requirements. Hydroelectric power is more costly in regions where coal or gas is accessible, and is the poorest employer of labour of any energy form.
11. The collateral advantages of gas for house heating—namely, automatic control, uniform temperature, freedom from ash handling, fuel storage, and firing, cleanliness, combustion without smoke, and stability of price—tend to compensate for any differential between its cost and that of crude fuels.
12. City gas has unique form value for industrial purposes where it serves simultaneously as the source of heat and as a chemical atmosphere to protect or process the work involved. Direct heating possible with gas promotes maximum efficiency by eliminating heat capacity and thermal barriers of unnecessary muffles, saggers, or baffles.

DISCO, A SMOKELESS FUEL*

By C. E. LESHER, *Pittsburgh Coal Carbonization Company*

ONE of the elements in the problem of smoke abatement is a solid smokeless fuel for hand-firing in stoves, grates, and furnaces of homes. The great central area of this country has an abundance of coal, but that coal is nearly all high volatile and produces smoke when burned in ordinary hand-fired apparatus.

The ideal fuel for hand-firing will be in sizable pieces of firm structure, free burning, easily ignitable, and smokeless. Partial coking of high-volatile coking coal gives a fuel that is smokeless, free burning, and easily ignitable. The product is soft coal with the smoke removed. Many devices have been invented to accomplish this result. The common failing has been that the semi-coke is in the form of char or that the process is too costly. Despite innumerable failures and disappointments, research has been steadily increasing our knowledge of coal and its processing. The current demand for smokeless fuel from high-volatile coal is giving impetus to the search for more and better methods of processing.

Manufacturing Process

Disco is a solid smokeless fuel made from bituminous coal by continuous low-temperature carbonization. Any bituminous coal with a certain minimum of coking property that becomes plastic within the temperature range of the present equipment can be successfully made into Disco.

At Pittsburgh Disco is made from a 35–37% volatile, coking, bituminous coal by a continuous process in revolving steel retorts. The product contains about 16% volatile matter, is smokeless, easily ignitable, free burning, and has a firm, dense structure. The plant has been in operation for seven years. There are three retorts or producing units. Production in 1940 was 71,000 tons in 326 working days. Two sizes are sold, 1 × 2 and 1 × 6 in. All breeze under 1 in. is crushed to —¼ in. and re-used in the retorts. There is no surplus gas for sale and the only by-product recovered is tar. Tar produced in 1940 was 1,500,000 gallons from 102,000 tons of coal processed. In 1940 about 33% of the Disco was used in Pittsburgh, 20% shipped to other points in Pennsylvania, 10% to Ontario, and the remainder to coal dealers in New York, Ohio, and eight other states.

Coal passing ⅛-in. screens is fed continuously to multiple-hearth rabble roasters, indirectly heated to 600°F., and charged in a measured continuous stream with a definite proportion of recirculated, heated, —¼-in. breeze to the rotating carbonizers. These are inclined steel cylinders with both external and internal heating. Gaseous products of distillation are withdrawn from the upper or charge end of the retort; the solid product is withdrawn from the lower end. Tar is collected by cooling the gas with direct water sprays, and the raw gas is burned in refractory furnaces, one for each unit. Solid product is collected in a conveyor, the larger pieces are broken to a maximum of 6–8 in., undersize is screened out, and the final product is air-cooled on a wharf and loaded into railroad cars.

Control of the process and product is by regulation of the temperature and time of pre-treatment, by ratio of recirculated breeze to coal, and by the time and temperature in the carbonizer.

Indirect heating is by high-speed combustion gas circulated by a fan. The highest temperature of the heating gas contacting steel is 1050°F. and the lowest at the fan, about 700°F. The combustion gases do not come in contact with the coal in process. Direct heating is obtained by partial combustion and is controlled by the quantity of air admitted to the interior of the apparatus. The addition of breeze to the coal charged into the retort not only gives a sensitive control on the operation, but improves the structure of the solid product. Twice each year the retorts are cooled and the scale and crust are removed.

The coal as charged into the retort at 600°F. is dry and granular. As it flows down the retort it is heated and becomes plastic. In this state it is formed into ball-shaped pieces that are uniformly dense and fine-grained and are self-trade-marked by the rounded, irregular shapes. The product is not briquetted or pressed. The form of the ball is determined by the rolling action of the retort on plastic material.

As it softens the coal becomes sticky. The dry material becomes wet in the plastic stage. Revolving action of the retort kneads the

* From *Industrial and Engineering Chemistry*.

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Gas Products Prices

The London Market

Aug. 18.

There are no changes to report in the price of Coal Tar Products in the London market, which remain approximately as below:

Pitch is nominal; creosote 4¾d. to 5d.; refined tar 3¾d. to 4d.; pure toluene under the Ministry of Supply Toluene No. 2 Order 2s. 5d.; pure benzole 1s. 10d.; 95/160 solvent naphtha 2s. 5d. to 2s. 8d., and 90/160 pyridine 13s. 6d.; all per gallon naked; refined crystal naphthalene £23 per ton in bags; all *ex* Makers' Works.

The Provinces

Aug. 18.

The average prices of gas-works products during the week were: Pitch and Crude Tar,* Toluole, naked, North, 1s. 10d. (controlled by the Control of Toluene No. 2 Order, July 5, which fixes the maximum price at which this material may be sold). Coal tar, crude naphtha, in bulk, North, 10d. to 11d. Solvent naphtha, naked, North, 1s. 9d. to 1s. 10d. Heavy naphtha North, 1s. 6d. to 1s. 7½d. Creosote, *ex* works, in bulk, North, liquid and salty, 4½d. to 4¾d.; Scotland, 4½d. to 4¾d.; low gravity, 4½d. to 4¾d. Fuel Grade, 4d. to 4¼d. Carbolic acid, 60's, 3s. 7½d. to 3s. 9d. Naphthalene, £12 to £15. Salts, 70s. to 80s., bags included. Anthracene, "A" quality, 4½d. to 4¾d. per minimum 40% purely nominal. Heavy oil: Unfiltered anthracene oil (min. gr. 1,080), 5¼d. to 5½d.; filtered heavy oil (min. gr. 1,080), 5¾d. to 6d.; heavy anthracene oil gr. less than 1,080, 6d. to 6¼d.

*In regard to pitch and crude tar prices we would ask readers to refer to the editorial note in our issue of Sept. 4, 1940, p. 404.

The Metropolitan Gas Company of Melbourne have cabled Messrs. William Coward & Co., Ltd., to the effect that the net profit for the year ended June 30 is £209,457. Transfer is £25,000, final dividend paid is 6s. 6d. per share, and the carried forward amount is £81,946.

Tar Products in Scotland

GLASGOW, Aug. 16.

Quietly steady conditions prevail in this district with prices showing no material alteration.

Refined tar is quite active at 4¾d. to 5d. per gallon for delivery in the home market and round 3½d. per gallon for export, both f.o.r. naked.

Creosote oil is well looked after at the following prices: Specification oil, 5¾d. to 6d. per gallon; low gravity, 6¼d. to 7d. per gallon; neutral oil, 6d. to 6½d. per gallon; all *ex* Works in bulk.

Cresylic acid is still difficult to secure for prompt and forward with values not lower than the following: Pale, 99/100%, 3s. 6d. to 3s. 9d. per gallon; Pale, 97/99%, 3s. 3d. to 3s. 6d. per gallon; Dark, 97/99%, 2s. 9d. to 3s. per gallon; all *ex* Works in buyers' packages.

Crude naphtha as available commands 6¼d. to 7¼d. per gallon *ex* Works in bulk, according to quality.

Solvent naphtha: 90/160 grade is 1s. 8¼d. to 1s. 9d. per gallon and 90/190 Heavy Naphtha is 1s. 4½d. to 1s. 5½d. per gallon.

Pyridines remain dull with prices nominal at about 14s. per gallon for 90/160 grade and 16s. per gallon for 90/140 grade.

The Directors of the Tottenham and District Gas Company have declared the undermentioned Dividends: Ordinary Stock 2½% actual, in respect of the half-year ended June 30, 1941. 5% Preference Stock 2½% actual, in respect of the half-year ended June 30, 1941. 5½% Preference Stock 2¾% actual, in respect of the half-year ended June 30, 1941. 6% Preference Stock 3% actual, in respect of the half-year ended June 30, 1941. All less income-tax at 10s. in the £.

Gas Stocks and Shares

Business on the Stock Exchange was on a smaller scale last week, and it is yet to be seen what effect the joint declaration by Mr. Churchill and President Roosevelt will have on markets. Gilt-edged were in good demand and several closed fractionally higher—2½% Consols remained at the previous week's level of 81¾. Home rails were easier at the opening, but the junior issues hardened as the week progressed. The industrial market made a rather irregular showing and some of the earlier gains among the leading shares were not maintained. Oil shares lacked interest and rubbers were dull. Some interest was taken in Far West Rand developing issues, otherwise the Kaffir market was quiet.

There was a comparatively large volume of business in the Gas Market last week, the effect of which can be seen in the lists below showing the number of upward movements in prices. Gas Light stocks were again in good demand and the 3½% maximum stock showed the highest gain with a rise of 6 points to 50½. Imperial Continental moved up again and closed 5 points higher at 64½, while South Metropolitan and United Kingdom ordinaries were also strong features. On the Provincial Exchange a small reaction took place in Newcastle Units.

The following quotations were altered during the week:

OFFICIAL LIST

Associated Gas & Water Ord. ..	13/—14/-	+-/3d.
Croydon Sliding Scale (*x.d.*) ...	85—90	Aug. 11
,, max. div. (*x.d.*) ...	80—85	,,
Gas Light 3½ p.c. max.	48—53	+6
,, 4 p.c. Pref.	62—67	+2
,, 3 p.c. Deb.	73—78	+1
Imperial Continental	62—67	+5
South-Eastern Gas Corporation Ord.	11/—13/-	+-/6d.
South Metropolitan Ord.	52—57	+3
,, 4 p.c. Pref. ...	57—62	+2
South Suburban Ord.	59—64	+1
United Kingdom Gas Corporation Ord.	11/—13/-	+-/6d.
United Kingdom Gas Corporation 4½ p.c. 2nd Pref.	10/6—12/6	+1/-

SUPPLEMENTARY LIST

East Surrey 5½ p.c. Pref.	85—90	+2½
Tottenham 5 p.c. Red. Mortgages	97—102	+¼

PROVINCIAL EXCHANGES

Chester United Ord. (*x.d.*)	96¾—99¾	Aug. 5
Newcastle Units	17/3—18/3	—-/3d.
,, 4 p.c. Pref.	81—82	—1
,, 5 p.c. Red. Deb.	100—102	+1½

Correction.—The quotation of Chester ordinary stock shown in the Lists published in the "JOURNAL" on July 2 and August 6 as 78–80 should read 98–101.

A.R.P.

PROTECTION OF SANDBAGS.

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SEP 26 1941

mass and disintegrates it into smaller masses which, being free to move down the retort, quickly harden and assume rounded shapes. The size of the pieces that finally appear as coke balls is determined by the agglutinating property of the coal at the time it reaches its softening temperature in the retort.

Coal Sources

Tests of many coals confirm the theory that low-temperature coke of good structure and size can be made in this process if due consideration is given to the plastic property of the coal. At one end of the scale is the coal with very strong agglutinating property, and the process requires that this property be reduced by preheating and partial surface oxidation in order to control the operation and to obtain satisfactory coke balls. On the other end of the scale is the poorly coking coal, and to obtain coke balls it is necessary to preheat rapidly without air in order to preserve and take advantage of all the coking property in that coal. The Disco process is thus adaptable to the full scale of coking coals.

Economics

Processing a smoke-producing high-volatile coal to make a solid smokeless fuel requires special equipment and costs money to operate. A process that removes the smoke decreases the weight of the product. Thus 100 tons of coal will make from 65 to 75 tons of smokeless fuel. If the coal has a value of $1.50 per ton, then the cost of the coal to make a ton of coke will be from $2.00 to $2.30. Direct operating costs—labour, supplies, power, pay-roll taxes, insurance, &c.—will range upward from a dollar per ton of Disco, depending on size and character of plant. Operating credits from by-products offset in part the operating cost. The quantities of by-products will vary with the coal and their value with the market.

On any basis of calculation, processed smokeless fuel will cost the consumer more per ton than well-prepared sized coal from the same mine. However, even the ordinary stove or house-heating furnace will get greater efficiency from a smokeless processed fuel than from raw coal. Fewer tons of such fuel will heat a house than of smoke-producing coal, and the measure of the increased cost will be the dollars spent in a year rather than the unit cost per ton.

NATIONAL DEFENCE*

By A. GORDON KING, *Secretary, American Gas Association Committee on National Defence*

IT is not necessary to advocate or labour the point as to the important part the Gas Industry plays in normal times in the home, in commerce, and in industry. In times of national emergency it is one of the great and essential tools for the production of war material; its ramifications in the great cities, the smaller communities, the munitions plants, the army camps and cantonments, are amazing. Curtailment or severance of service is totally unthinkable. Now as all of us know the only information as to what is happening to the production plants, transmission, and distribution systems and all the accessory equipment under war conditions is the reports from visitors to Europe, articles and items in the trade Press of the Industry and if intelligently studied, both newspaper and magazine articles as well as photographs, and particularly the news-reels.

We have collected and studied much of this information. A committee of the Technical Section is busy analysing the many articles and special publications issued in Europe and the United States.

The attacks on the producing plants, and they are practically all manufactured gas properties, seem, according to the information we have received, to divide themselves up into two classes. These are the attacks from within, and the attacks from without; by this segregation I have in mind in the first class the attempts made by the saboteur, the Fifth Columnist or whatever name you elect to designate this unhealthy un-American verminous appendix. In the second division I have in mind the attack chiefly from the air and under certain geographical conditions from artillery or from aboard ship.

Now the saboteur and the Fifth Columnist in so far as the organization and the property of the Gas Industry are concerned can, I believe, be well handled by Americans. They do not have to learn from those who are fighting against a hated form of government on their own soil how to handle such individuals, although they well may learn some of the methods employed to destroy both properties and personnel. We have our local peace officers, in many cases State Police, the Federal Bureau of Investigation of the Department of Justice, and our own good horse sense, plus a wide-awake loyalty of our associates.

In considering the information that should be available and the best means of securing it, the Executive Board authorized, at the request of the Association's Committee on National Defence, the Technical Section to proceed with collecting information looking toward a summary of different methods of plant protection that have been adopted in this country, and perhaps Canada.

Under the direction of Chairman Hartson, a committee which was considered to be especially well qualified sat down and prepared questions to be sent to all of the gas companies in this country and Canada. The personnel of the Committee included production, distribution and chemical engineers, statisticians, motor vehicle operators and a natural gas engineer.

The questionnaire is being handled entirely by the Association's Statistical Department, and all replies as they are received are kept within that group and no one else is advised of the identity or origin of the answers. All questions were arranged to be answered by an affirmative "yes" or a negative "no."

I am advised by the Association's Statistical Department that the response is excellent and that replies are coming in from all over the country. Further, that some of them are exceedingly interesting. As of April 14, 50.2% of the Manufactured Gas Meters and 26.1% of the Natural Gas Meters have reported.

To date there have been exceedingly few who have refused to comply, and there have been some who felt such an unswerving and unwavering belief in the loyalty of their employees as clearly to indicate "it could not happen here."

Perhaps the most striking thing which has so far appeared from this activity is the fact that the questionnaire appears to be serving two purposes. The first is as was intended—*i.e.*, the Association should secure accurate information as to the protective methods adopted so that the information in the aggregate may be used for the benefit of the Industry as a whole. Consideration must be given to the fact that the various government departments, including the Army and Navy, as well as the Department of Justice, will—some have already done so—require such information from the Association.

The second was the thought that a listing of questions might be so thought-provoking as to be educational and informative. This has proved to be the case.

Now I shall not attempt to try to say to you against whom or what we are discussing defensive measures, nor would I attempt at this time to guess, should such attacks occur, from where they might originate. Rather does it seem to me our duty is clear. We have had committed to our charge properties of various types and systems of different kinds all engaged to some degree in furnishing a vital fuel service to this nation. In some parts it is domestic only; in others it may be domestic and industrial, and in others it may be employed in the most vital of war measures.

A characteristic of the Gas Industry in this country is the individual operation of the individual plant generally under the direction of an individual and his staff, located in the area where the gas is furnished to a community. Therefore, no two situations could ever be alike and no specific rules or regulations can be promulgated.

From the day the Gas Industry first turned gas into the mains to proceed through the services and meters to the now, to us, old fashioned lighting fixtures, continuity of service has been one of the unwritten rules. Therefore it seems to me that our duty lies before us sharply defined and simply stated. It is, no matter what the conditions, either from within or without, that we must ever maintain the service.

Down through all the years when gas made its periodic fights against the competition of other sources of light and heat, the Industry waged a winning fight and emerged stronger than ever before.

As engineers we obviously will not be remiss in looking into all those things which could serve to destroy or impair that continuity of service, again either from within or without. As I hope I have indicated it is my firm belief that we can, with skilled assistance and knowledge we could not in normal circumstances be expected to possess, handle ourselves and our properties in regard to attacks from within.

In regard to the attack from without, I believe we should study all we can as to what is happening on the other side and endeavour to view through those spectacles our own plant and distribution system situations. It would seem axiomatic to me that after studying the things that should be done then the things which must be done stick out like sore thumbs. Many of them we shall automatically take in our stride. Distribution men from those sections of this great country who have had to meet the damage and destruction by natural causes have handled themselves and their properties amazingly well and are equipped for many of the emergencies which might come to us.

I say to you in all earnestness that because I know you all so well and what you stand for; because I know something of the splendid history of the Gas Industry; and because I know that it is second nature for the gas engineer to believe in and practise the continuity of service, therefore I know in my own heart what we shall do in the emergency, should it come. We shall prepare ourselves and our properties. We shall find out what the other fellow has done under conditions which it is hard to believe human beings and physical equipment could withstand—and we shall adapt the best of them to our present situation. There may be no uniforms and there may be no flags and there certainly will be no bands, but there will and must be a deep and abiding sense of satisfaction in having done the job assigned to us—than which no greater praise can be had.

* From a Paper presented at American Gas Association, Technical Section, Eighteenth Annual Distribution Conference, Pittsburgh, April 21, 1941.

"Thank you Very Much" was the remark of Alderman Matthews, when consideration was being given by the Stratford-upon-Avon Town Council to the twentieth annual report of the Gas Engineer and Manager, Mr. F. Shewring. He said that during the whole of this time they had been exceptionally free from gas difficulties in the town; the undertaking had run very smoothly. Alderman Smith endorsed what had been said about Mr. Shewring, and wished they could acknowledge his work in a practical manner. Councillor Reynolds pointed out that under present conditions the Council were not allowed to publish the report, but the results were eminently satisfactory and fully justified extensions that had been decided upon.